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Early Entry Forces: An Annotated Briefing on the Question of New and Nonconventional Threats

Maurice Eisenstein

Arroyo Center

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Maurice Eisenstein

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DB-111-A

PREFACE

With the demise of the Soviet Union and Warsaw Pact have come a reevaluation and restructuring of U.S. military doctrine and force structure. In the aftermath of the cold war, instabilities have arisen as a result of the transformation of Communist nations toward more democratic and capitalist societies, a resurgence of religious fundamentalism, and the renewal of ancient ethnic tensions that have lain dormant for decades. In some regions of the world, U.S. interests could be at risk and may require the use of military force. The Early Entry Battle Laboratory at Fort Monroe, Virginia, has the task of determining for the Army how its initial combat troops, in conjunction with the other participating services, should prepare its arms, equipment, and capability to pave the way for follow-on U.S. forces.

This annotated briefing is the result of a three-week effort to identify new and nonconventional threats that early entry forces (EEF) might have to contend with, and to begin a dialog about possible responses by the EEF to those threats. The research was sponsored by Hqs U.S. Army (DACS-DPM) and was conducted in the Arroyo Center's Force Development and Technology Program, which is directed by Dr. Kenneth Horn. The Arroyo Center is a federally funded research and development center sponsored by the United States Army.

The EEF mission will be multiservice, so that this work should be of interest to elements of each of the services who plan and perform EEF missions, including USCENTCOM, FORSCOM, Deputy Chief of Staff for Operations, Force Development, and their service counterparts. This work should also be of interest to the research and development (R&D) elements of the Department of Defense, including the Ballistic Missile Defense Organization, Space & Strategic Defense Command, and others involved in developing active and passive defenses that might be employed in an EEF mission.

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EEF BRIEFING SUMMARY

A short-term three-week special assistance effort was undertaken to identify what emerging threats early entry forces (EEF) might have to contend with and what potential EEF responses might be to those threats. The results of this effort were used in developing a dialog with the Early Entry Battle Laboratory at Fort Monroe, Virginia.

To appreciate how some emerging threats could affect EEF operations, a scenario was considered in which the U.S. Air Force newly occupied a foreign air base and Army ground forces were deployed in proximity to the air base over an area of about 18 square kilometers to protect against enemy counterattacks. The Air Force flew air defense, air cover for ground troops (air cap), and reconnaissance missions while landing troops and equipment. The command, control, and communications (C3) headquarters were located at the air base. Enemy forces were out of base artillery range but were within range of theater ballistic missiles (TBMs) and eventually in range of their cruise missiles as well. The EEF mission was to protect the air base from ground attack for about five days until a larger contingent of forces could arrive.

The threats considered were categorized as near and far term, conventional and nonconventional. The assessment of threat to the air base and ground forces was based, to a large extent, on past RAND study efforts. The alternative EEF responses identified in this study were selected based on their potential capability to defend the EEF troops and the occupied air base. Such responses could be part of the EEF order of battle, or, if possible, prepositioned depending on the country and location of the conflict.

Near-Term Conventional Threat—1995

TBMs with unitary high-explosive (HE) warheads were considered in attacking both the ground forces and the air base. Some 2500 to 3000 TBMs are believed to be deployed in countries outside of the former USSR. Ninety-eight percent of these missiles have ranges of 500 km or less. It was concluded that these near-term TBMs with their large CEPs (300 meters or more) were not a significant threat to the EEF ground forces or to the operations of the air base. Excessively large numbers of TBMs, estimated at perhaps 40 or more, with unitary warheads would be required to crater the air base runways sufficiently to halt air operations. Similarly, the two or so battalions of Army combat troops deployed around the air base were not considered at risk from such attacks, because the TBMs are generally inaccurate and not cost-effective to the enemy.

The primary response to this near-term theater missile defense (TMD) threat was to ensure that aircraft at the air base unloaded as expeditiously as possible and that personnel and cargo dispersed away from the runways as soon as possible. If the enemy continued to launch TBMs against the air base, the base could be closed from time to time to inspect for runway damage. If the air base was closed for any significant length of time, it might be prudent for the EEF to have a backup air defense capability, such as Patriot Pac III fire batteries or an air defense fire battery composed of Vulcan and Stinger surface-to-air missiles (SAMs).

Far-Term Conventional Threats—2000+

In the far term, there is the potential for more accurate TBMs and cruise missiles with advanced conventional warheads. Missiles with CEPs of 50 meters and warheads that carry many tens of submunitions that can arm or explode on impact were considered to be part of the far-term threat. The potential for shutting down air base runways with TBM submunitions that arm on impact is quite high even for a TBM with 300 meter CEPs. Armed submunitions scattered along air base runways would have to be removed before air operations could resume. Safe removal of the mines could take hours.

The impact of a threat of TBMs armed with anti-personnel submunitions against dispersed Army ground forces was considered to be about the same as an artillery attack when ground forces are trained to properly respond. Warning of a TBM attack would greatly aid in the ground troops' ability to take protective cover. The results from cruise missile attacks would be about the same as from a TBM attack.

Whereas the introduction of a TMD, such as Patriot Pac III, could help mitigate a TBM attack with unitary warheads, it would probably require at least an upper tier interception, but more likely a boost or ascent phase interception capability to destroy the TBM before it could disperse its submunitions. Upgrades to Airborne Warning and Control System (AWACS) or Patriot would be necessary to defend against cruise missiles, especially if they became stealthy. An additional response might be to deploy an engineering company capable of rapidly clearing mines from runways with specially adapted equipment, such as heavy-duty expendable blades attached to a light tank or high-pressure water hoses behind protective barriers to push mines off the runway. The same engineering company could be equipped to rapidly restore the runway to operational condition by filling craters caused by exploding submunitions.

The Near-Term Nonconventional Threat—1995

The primary nonconventional threat to the EEF in the near term would be from chemical warfare, particularly if delivered and dispersed from unitary TBM warheads. Unprotected forces could result in extensive casualties. Unprotected equipment with electronic or electrical components can be ruined. An air base attacked by TBMs with chemical agents could be closed down for many hours until the base was sufficiently decontaminated to safely restart operations. Of special concern is the warning time available to the EEF personnel to respond to a chemical weapons (CW) attack with short-range TBMs. The flight time of a 100-km TBM is about three to four minutes from launch to impact. It is estimated that eight to ten minutes of warning time is required to ensure that proper protective measures can be taken by the troops (donning masks and protective [MOPP] clothing).

There is further concern that communications to the dispersed EEF forces around the air base could be jammed to preclude warning of a TBM attack, even of longer-range TBMs. The detection and warning of a missile launch from a Defense Support Program (DSP) satellite passes through Colorado Springs and on to the field forces through a defense communications satellite. It is estimated that a 100-watt jammer aboard an enemy aircraft 100 km away would be sufficient to jam the satellite downlink to the field forces and, with sufficient jammer power, between a command site and the locally deployed troops as well.

The introduction of TMD could significantly increase the number of attacking CW TBMs with unitary warheads needed on a target to achieve a desired outcome. Intercepting unitary CW warheads at relatively high altitudes could reduce the amount of chemical that actually lands on the target. This would enhance the effectiveness of protective measures the troops would take, thus reducing the numbers of casualties. It is uncertain, however, by how much the reduced quantities of CW would limit damage to equipment or increase casualties in nearby civilian populations. It would be important for the EEF to also consider additional CW defenses to ensure better personnel protection and more rapid decontamination of the air base to get air operations up again. To eliminate any CW falling on the target would require a boost or ascent phase interception capability.

The Air Force is considering the development of the Peregrine boost phase defense, but such a system is not likely to be available until the next decade. The Peregrine, or a manned or unmanned airborne system with comparable sensors such as the F15, could detect the launch of short-range TBMs that were not detected by the DSP early warning satellite, thus giving warning time to take protective measures. This assumes that the airborne surveillance systems are part of the command and control network associated with the EEF operations. Again, given that the air base could be out of operation for some number of hours after a CW attack, it would be prudent for the EEF to consider a backup air defense capability to protect against enemy air attacks on the air base and on the deployed Army troops. That is, the enemy may launch a two-phase attack that leads with a TBM phase using CW warheads followed by either a cruise missile (CM) or aircraft attack on the EEF and the air base that it is deployed to protect.

The Far-Term Nonconventional Threat—2000+

In this era, concern is for the simultaneous use of conventional and nonconventional submunitions on TBMs to ensure that any runway repair activity will have to wait until decontamination is completed, perhaps many hours. Alternatively, the cleaning and repair of the runways could take place while the troops are wearing MOPP gear and gas masks. Either approach will take at least a half day and probably more. Again, there is concern that there will be inadequate warning to the troops of a short-range TBM attack, or that communication of attack warning will be jammed. Cruise missiles can also deliver these types of attacks against airfields and ground forces, and in many ways CMs are even more difficult to detect.

The responses described for TBM and CM attack will pertain here, as well, thus introducing boost phase TMD, improved CW defenses, extra engineering capabilities, improved warning time, and so forth. Terminal TMD may not be effective against TBMs with submunitions. If heavy CW attacks continue, it may be necessary to abandon the air base and retreat. It may be that this extreme threat is impossible for the EEF to deal with in any rational way, and that any useful response might have to consider the threat of U.S. military escalation to deter such attacks. If a retaliatory doctrine is established, it could limit the need for extra CW defenses, and the TMD would remain concerned with conventional warheads alone.

SUMMARY REMARKS

The threats described above already exist. They may not be in the countries currently of concern to US security interests; however, it is difficult to predict when these threats will materialize in a particular region. The Army EEF will have to prepare, nonetheless, for future combat missions where these threats may exist. It is essential that the EEF review and develop a plan for responding to these threats on the basis of the cost and benefits associated with each potential response option. The availability, effectiveness, and cost for each option need to be considered. For the EEF, it is close to being a zero-sum game, that is, for each additional new capability or system added to its operational inventory, something else will be left behind or arrive at a later time. Some capabilities can be shared with the Air Force, others may be unique to one of the services.

In any event, it seems clear that warning of the launch of a short-range (i.e., up to 300 km) TBM is needed to ensure that the EEF has the time for minimal protective procedures. This is particularly important because (1) this threat is dominant today and is expected to continue well into the post-2000 time period, (2) our current warning systems are not capable of providing launch detection, and (3) the current TMD effort is focused on the emerging longer-range TBM threat. From a broader perspective, how the EEF respond will depend on whether there is a U.S. doctrine to deter the use of CW in future conflicts. Dealing with these new threats needs to be considered by the individual services, but a joint response also needs to be devised.

Early Entry Forces: A Question of New and Nonconventional Threats

A Discussion of the Issues

October 1993

This Arroyo Center study was prepared for presentation to the Army's Early Entry Battle Laboratory at Fort Monroe, Virginia, in August 1993. It represents the results of a special assistance study to examine the implications of the theater ballistic missile and other threats for operations being considered by the Early Entry Battle Lab. This presentation was intended to raise issues and questions regarding future threats to EEF missions and to begin to identify possible responses to those threats.

Does EEF Planning Need to Consider Other Conventional and Nonconventional Threats?

- **Missiles, weapons of mass destruction, and other military technologies are proliferating**
  - **How might they affect EEF performance?**
  - **How might the EEF respond?**
- **This discussion reviews the findings of a three-week survey conducted by RAND**

Figure 1—Does EEF Planning Need to Consider Other Conventional and Nonconventional Threats?

The proliferation of advanced weapons technologies and weapons of mass destruction could affect U.S. force projection policies, particularly the ability of early entry forces (EEF) to achieve their mission. Of concern are the proliferation of ballistic missiles and the prospect for improved ballistic and cruise missiles in the future. Also of concern is the possible use of chemical weapons (CW) against early entry ground forces and the facilities they are protecting. The need for rapid warning of a CW attack raised concern about enemy use of jammers to prevent the timely communication of warning to the EEF troops deployed at a distance from their headquarters.

A three-week effort was undertaken to review the possibilities of how these new and nonconventional weapons could affect EEF performance, and to identify conceptually what responses were available to the EEF to mitigate the effect of these weapons if introduced. Given the short period of time to conduct this review, the data used here were taken from previous RAND studies and from unclassified government publications. As a consequence, there may be small variations in the numbers shown for scenarios resembling one another. These variations result from the different performance assumptions used in the various studies that we draw upon for this briefing. This briefing discusses the results of our short-term effort.

A Summary of Responses

	Defense of	
	Air Base	Ground Forces
Current Threat • CW TBM • TBM	• Add CW defense equipment • SAM-manpads • Rapid troop deployment	• Add CW defense equipment • SAM-manpads Note: manpads = man portable air defense.
Future Threat • TBMs accurate – Submunitions • Cruise missiles • CW • Radio jamming	• Improved warning • Active vs. passive measures; CW, conventional • SAM-manpads • Rapid deployment • CW jamming	• Improved warning • Active CM/TBM defense vs. CW passive measures • SAM-manpads • Anti-jam radio

Figure 2—A Summary of Responses

Figure 2 summarizes possible responses to defending an air base and early entry ground forces defending that base against attacks by current and future weapons. Current threats exist today, and future threats are generally expected to appear among developing nations by early in the next decade. Some threats discussed in this review are not anticipated until an uncertain future time, while others, such as theater ballistic missiles (TBMs), are here now and are expected to become more accuate and sophisticated in the future. Thus, some threats we will discuss have not been validated by intelligence, while others certainly have.

Defense responses for both the current and future threats are tabulated according to whether the attack is against an air base that the EEF is to keep open or against the EEF ground forces themselves. In this briefing, we will describe each of the threats, current and future, discuss their potential impact on the EEF and the EEF mission, and identify what may be candidate responses, both active and passive, to meet these threats. We will also expand upon this summary Vu-graph to discuss possible priorities among these candidate responses for inclusion with the early entry forces.

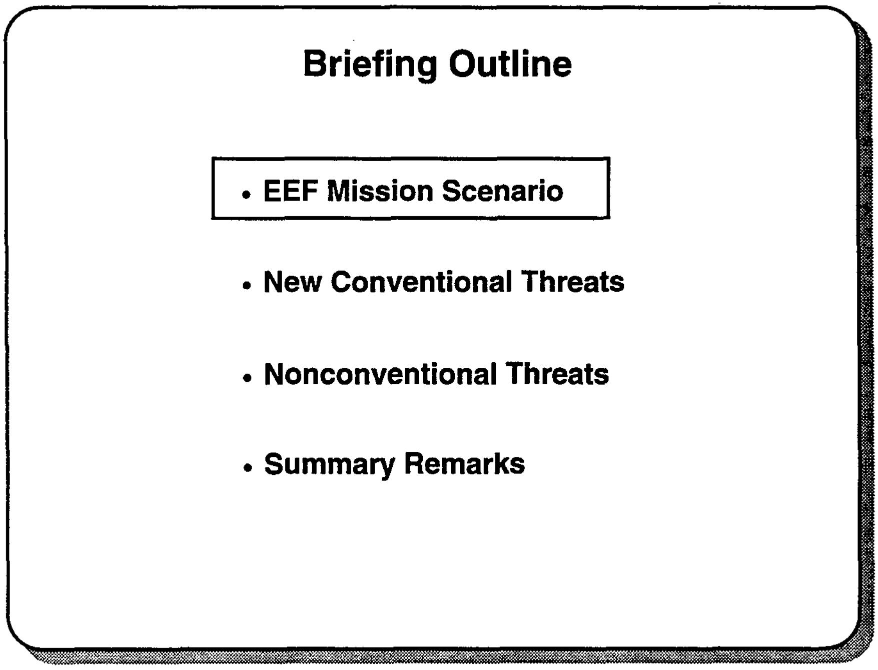

Figure 3—Briefing Outline

We will first identify and describe an EEF scenario around which our discussion will center. We then proceed to review the new conventional threats, their impact on EEF performance, and the possible EEF responses to meet those threats. This will be followed by a similar exposition and treatment of the nonconventional threats. Our thoughts and reflections on these matters will then be discussed and summarized.

There Are Many Potential EEF Operational Scenarios

First 5 Days Mission

- **EEF operations worldwide—service coordination**
- **EEF mission objectives**
  - Hold and protect important military bases
  - Inhibit progress of enemy land forces
  - Apply counterforce aggressively against enemy
- **Operational assumptions for this survey:**
  - Defense of an operational air base
  - U.S. maintains air superiority
  - Enemy artillery out of range or suppressed
  - Air forces provide recon and cover for ground forces
  - Coordinated C^3I

Figure 4—There Are Many Potential EEF Operational Scenarios

In our review we recognized that EEF operations could be called for in many different regions around the world and in many different environments. In our analyses, we assumed the primary EEF mission would be for the first five days of an operation in preparation for the arrival of additional military forces. We also recognized that the EEF mission could vary according to the prevailing circumstances and the nature of the conflict calling for U.S. involvement. We decided to consider a scenario focusing on an EEF mission to operate and defend an air base from enemy attack.

In this scenario, we assumed that the air base was protected by EEF forces under the threat of an attack. Our scenario begins with the assumption that U.S. air forces are operating from this air base, have invoked air superiority, are flying air cap and reconnaissance missions, thus allowing the base to be used for receiving troops and supplies by airlift. We have also assumed that enemy forces are beyond artillery range of the air base. If they were in artillery range of the air base, the airlift would likely be halted and enemy use of ballistic missiles might not be required. We have also assumed that the EEF command, control, and center of communications (C3) would be located at the defended air base and that there would be coordinated C3I between all service components involved in the operation.

The objective of the opposing forces is to close down the air base, while that of the EEF is to keep it defended and operational until additional military forces can arrive and take the land battle to the enemy.

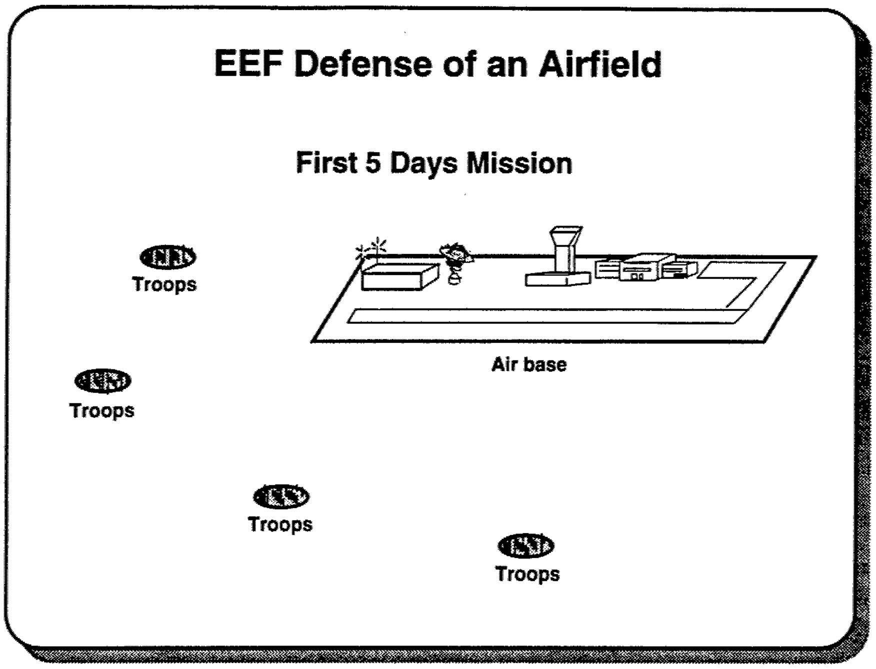

Figure 5—EEF Defense of an Airfield

Figure 5 illustrates the general deployment of one or more EEF ground force battalions envisioned in the scenario in relation to the defended air base. Each troop location shown here represents at least a company-sized deployment within a few kilometers of the air base and covering several square kilometers. The primary communication node is at the air base. We also assumed that the deployed battalions will be accompanied by artillery and air defense forces deployed in proximity to the air base and ground forces. An engineering company and other supporting forces may be included, and a total number of nearly 2000 Army troops are assumed to be part of the EEF. For this exercise we have assumed the air base runway to be between 2000 and 3000 km long.

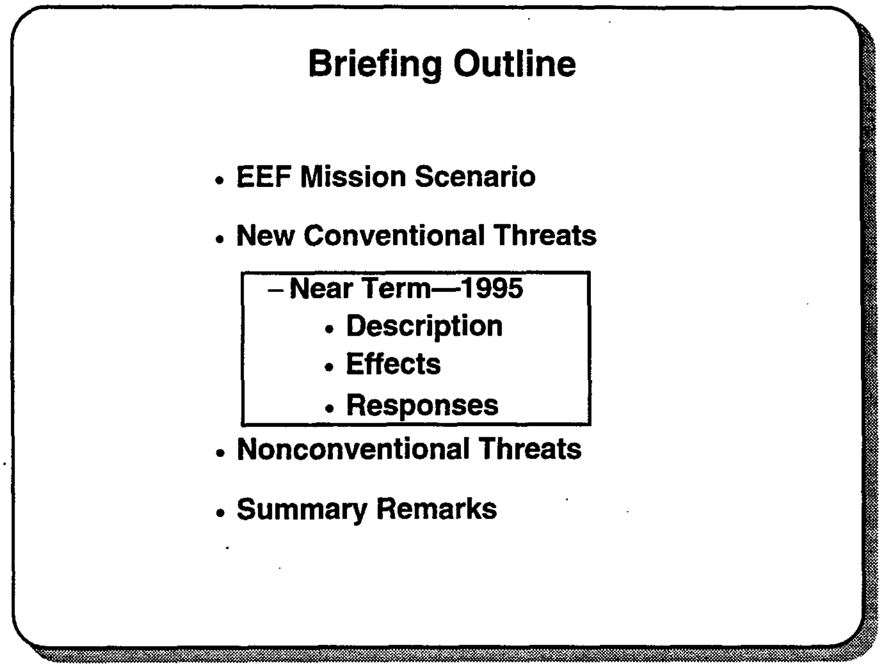

Figure 6—Briefing Outline

Using the EEF scenario described previously, we now describe the nature and capability of the conventional threats now and in the near term. We will discuss how these new systems might be used and how they could affect EEF performance, and what possible responses there might be for the EEF to mitigate the effects of those threats. These responses could include active defenses, operational adjustments on the battlefield, or the greater use of passive defensive measures, both new and existing.

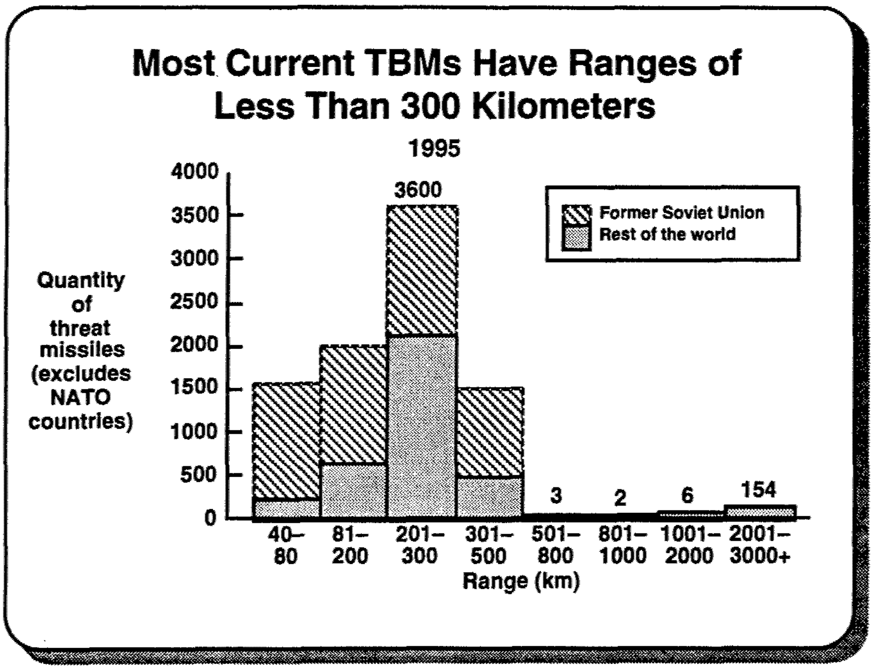

Figure 7—Most Current TBMs Have Ranges of Less Than 300 Kilometers

Figure 7 shows that there are more than 3000 theater ballistic missiles with ranges of 3000 km or less now estimated to be located in countries outside of NATO and the former Soviet Union (FSU). The vast majority of these missiles, however, have ranges less than 300 km. Many of these missiles are located in regions such as southwest and northeast Asia and northern Africa, where there are important U.S. and NATO interests. Many are SCUD-type missiles originally from the FSU or are derivatives produced in North Korea. China has also become an important supplier of short-range ballistic missiles, particularly to countries in South Asia and the Persian Gulf. Other Third World countries, such as Brazil, India, Iraq, and Pakistan, are producing or developing ballistic missiles. Many industrial countries, including the United States, have exported technologies that have supported the development of these less sophisticated missiles in the Third World. During Desert Storm Iraq launched more than 60 ballistic missiles into Israel and Saudi Arabia.

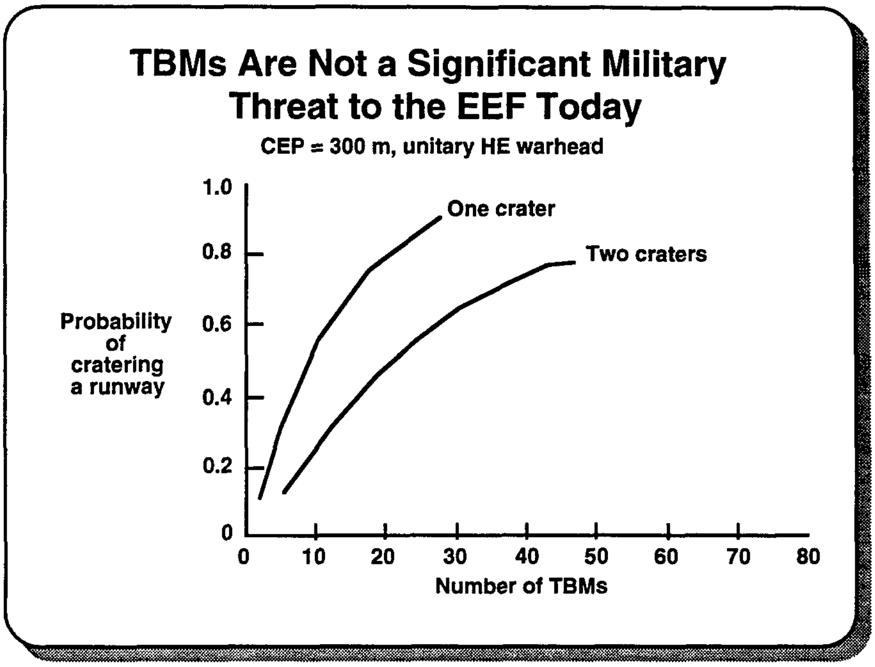

Figure 8—TBMs Are Not a Significant Military Threat to the EEF Today

Existing TBMs in Third World arsenals today are not believed to be a significant military threat to the EEF. All Third World missiles today deliver a unitary warhead, usually containing high explosives, and are generally too inaccurate (CEPs > 300 m) to inflict damage against a point or small target. Figure 8 shows the number of TBMs with 300-m CEPs needed to achieve a given probability of causing one or two craters on a runway. About 25 of these inaccurate TBMs would be required to attain a 0.90 probability of causing a single crater, and more than twice that number to ensure a 0.90 probability of creating two craters at different locations along the runway. Thus, a typical runway of 9000 feet might be closed to an airlift of cargo aircraft if the runway was cratered in the middle and cargo aircraft required more than 4500 feet for landing or takeoff. Two craters on a runway would halt aircraft takeoff and landing operations requiring more than 3000 feet of runway. Some fighter aircraft, however, might still perform with less than 3000 feet of usable runway.

We conclude that the use of current TBMs to effectively close an air base is probably impractical, particularly if there is more than a single runway.

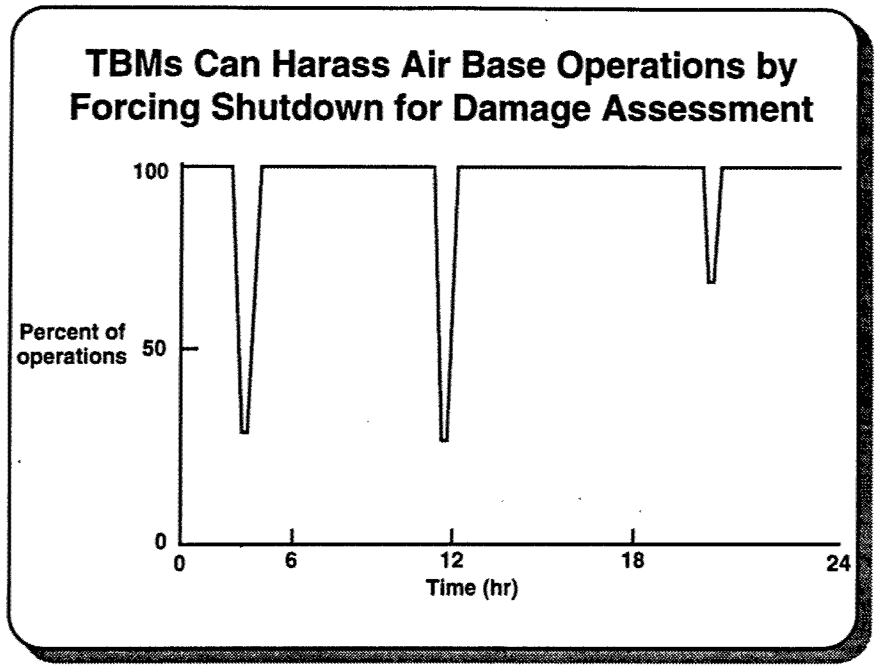

Figure 9—TBMs Can Harass Air Base Operations by Forcing Shutdown for Damage Assessment

Figure 9 shows how a TBM attack with unitary warheads might affect operations on an air base. Specifically, we anticipate that an air base might have to close down most or all flight operations for an hour or so to look for possible debris scattered along the runway or for repair of damage to the runways, particularly if one or more TBMs were to impact anywhere near the base. Overall, we expect that the effect would be small. A sustained TBM attack would require a very large inventory of TBMs.

Cruise Missiles Are a Non Threat in the Near Term—1995

- Low-altitude cruise missiles are predominantly short-range and anti-ship
- High-altitude cruise missiles only in FSU inventory
- Accurate, low-altitude, low-cross-section cruise missile threat for land attack is not expected before 2000

Figure 10—Cruise Missiles Are a Non Threat in the Near Term–1995

Our preliminary review of a cruise missile threat indicates that most such systems owned by Third World countries are designed exclusively for use against ships at sea. While many versions of Russian, Chinese, French, or Italian supplied anti-ship cruise missiles exist among Third World arsenals, none is known to have been converted to surface-to-surface or air-to-surface cruise missiles to attack ground targets.

High-altitude long-range cruise missiles are in Russia's inventory, but there is no indication that these weapons have been exported to other countries. All indications are that accurate longer-range cruise missiles such as the U.S. Tomahawk will not likely be available to Third World countries until well into the next decade. By the nature of their size, cruise missiles do not have large radar cross sections, and thus may be difficult for radars to see at extended ranges. Future cruise missiles could become much more stealthy, and thus even more difficult for radars to see and track.

Current TBM Threat Is Limited...
Needs Limited Response

- **Current TBMs have limited capability**
  - **Unitary warheads**
  - **CEP ≥ 300 m**
  - **Reload and launch time ≥ 1 hour**
  - **Limited capability to coordinate launches**
- **Can harass air base operations and inflict limited damage**
- **Not a threat to dispersed ground forces**
- **Responses:**
  - **Rapid deplaning and dispersal of troops and supplies**
  - **If air superiority uncertain, maybe use Patriot**

Figure 11—Current TBM Threat Is Limited, Needs Limited Response

We conclude that the threat of current TBMs to the EEF mission is limited and will be used primarily for harassment of air bases and other area targets. In our scenario, they will have a limited ability to affect flight operations.[1] We see no significant threat from these TBMs to the ground-deployed EEF.

The primary response to this threat would be to ensure that upon landing cargo aircraft are rapidly unloaded, and that ground personnel rapidly disperse from the air base. A missile attack warning system at the air base would be useful to ensure aircraft do not attempt to land while a missile attack is under way.

There may be concern when air operations are down even for relatively short periods that ground EEF would become vulnerable to enemy air attack. If such were the case, it might be useful to contemplate having a Patriot firing battery available that could serve as both an air and missile

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[1]It is well recognized that TBMs can be useful as strategic weapons when used against civilian population centers. We do not focus on this issue, but recognize that future EEF responses to these threats can be dictated by a political concern for TBM attacks against populations.

defense system. A Patriot firing battery consisting of eight launchers would require some 25 C-141s and one C-5 aircraft to airlift.

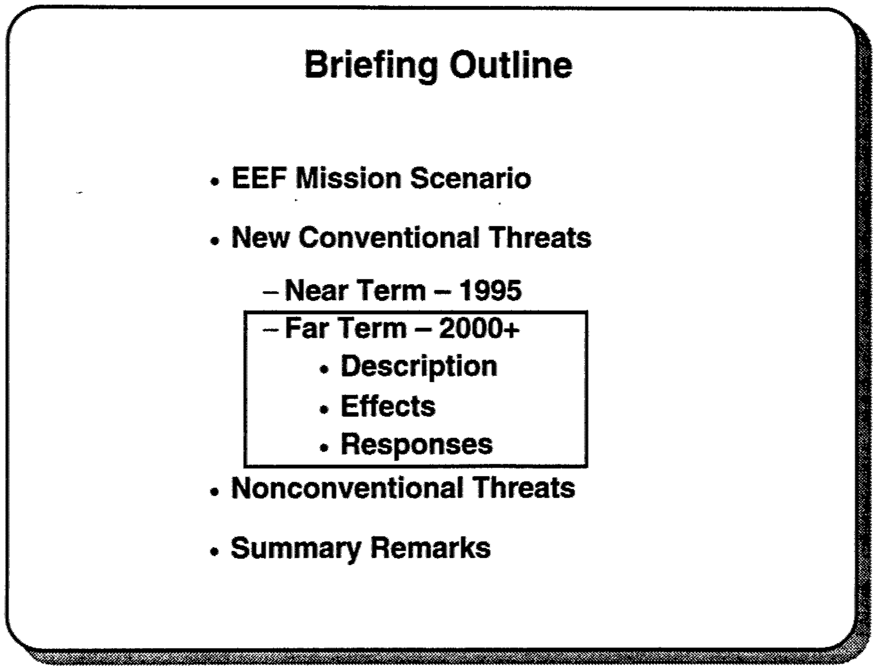

Figure 12—Briefing Outline

We now turn to new conventional threats in the far term, in the year 2000 and beyond. Our concerns will be on the introduction of new and improved TBMs and cruise missiles and their potential impact upon the EEF and its mission.

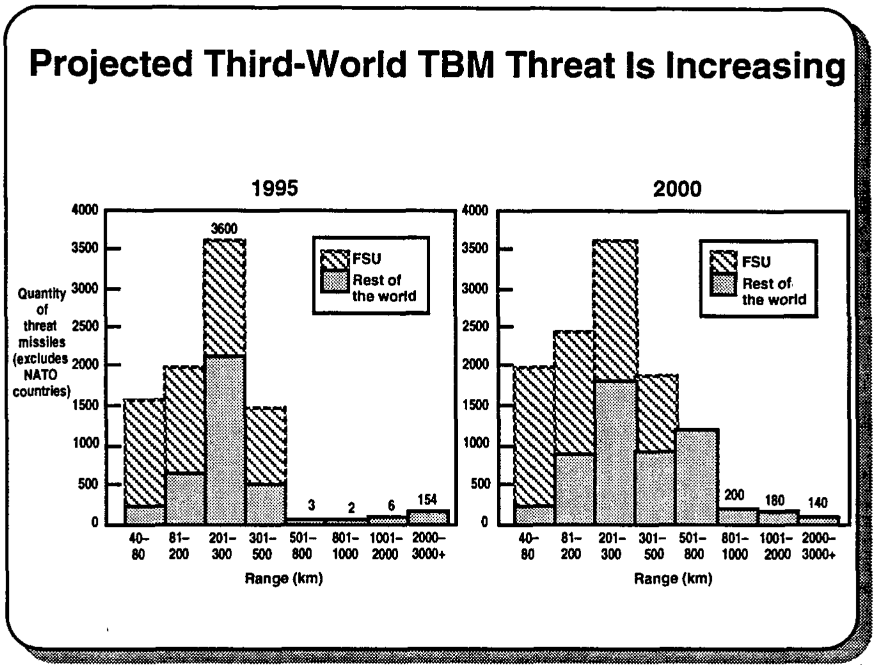

Figure 13—Projected Third-World TBM Threat Is Increasing

Figure 13 shows the number of TBMs expected to be deployed by the beginning of the next decade outside of NATO and the FSU. The total number of TBMs in Third World countries is expected to nearly double to well over 5000, with more than 4500 of these having ranges of less than 800 km and nearly 3000 having ranges less than 300 km. The implicit assumption underlying these charts is that all these missiles expected to be built in the remainder of this decade by the FSU will remain in the FSU. What we can surely anticipate over time is that many more nations will have many more TBMs, and that some Third World nations will have several hundred missiles in their stockpiles.

The Projected TBM Threat Is Also Increasing

	Near Term	Far Term
• Accuracy	300 m	50 m
• Warhead	Unitary HE	Unitary HE submunitions*
• Reload/launch	> hour	≤ hour
• Simultaneous launch capability	Limited: a few/hr	Increasing a few/minute
• Time of flight	3–4 minutes	3–4 minutes

* Not yet "validated" as a future threat

Figure 14—The Projected TBM Threat Is Also Increasing

In addition to their increasing numbers, TBMs are expected to improve in performance. TBM accuracy is expected to improve to reach CEPs of 50 meters from today's estimated TBM accuracy of 300 meters. While no specific evidence has been located to validate that Third World missiles will contain mines or anti-personnel submunitions in the next decade, we can not discount that possibility. We must also anticipate that Third World countries will advance in their ability to rapidly reload their missile launchers, and to improve their command and control to allow for simultaneous or higher rates of launch than are currently achievable. While this review does not explicitly consider how Third World countries will be able to accurately locate targets for their TBM attacks, it is assumed they will use global locating systems, commercial satellite mapping, unsophisticated intelligence satellites deployed by these Third World nations, as well as other traditional reconnaissance means. Later in this briefing this subject will be revisited.

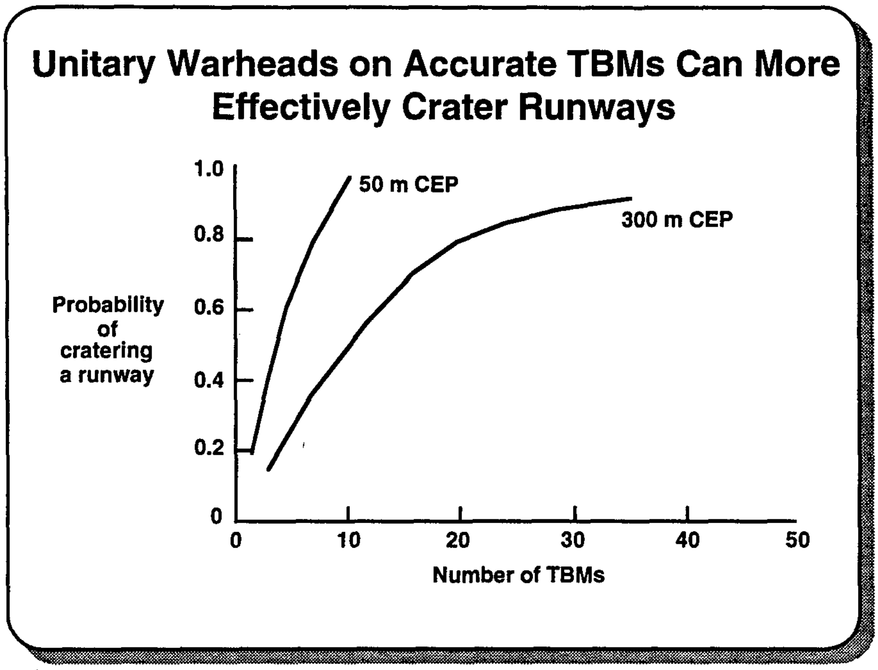

Figure 15—Unitary Warheads on Accurate TBMs Can More Effectively Crater Runways

Figure 15 shows the number of TBMs with 50 meter and 300 meter CEPs that are needed to cause a single crater on a runway to a given level of probability. About 8 of the more accurate TBMs with 50 meter CEPs are needed to achieve a 0.90 probability of cratering a runway as compared to about 25 TBMs with 300 meter CEPs. With the launch of about 20 TBMs with 50 meter CEPs, two craters could be expected along a targeted runway. This is not an inexpensive way for an enemy to close an airport, especially if repairs to the runway could be completed in a matter of a few hours and all operations resumed. If these more accurate TBMs could rain in at hourly intervals to the air base, they could disrupt base operations by requiring a halt to flight operations to assess the increasing possibility of debris being spread along the runway or of damage to the runways. Thus, while these more accurate TBMs may be an expensive way to crater an air base runway, they nonetheless may be capable of continually disrupting air base operations.

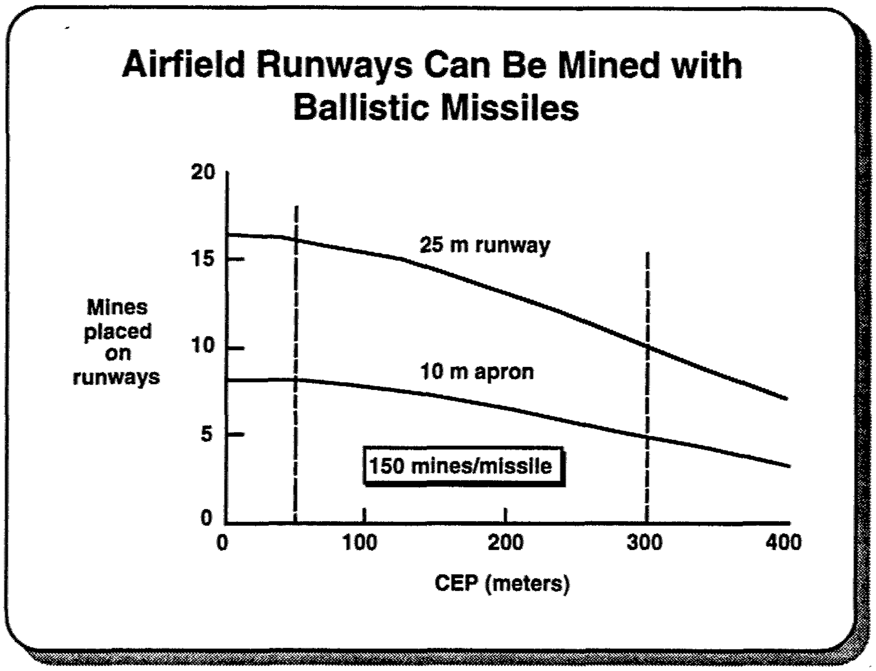

Figure 16—Airfield Runways Can Be Mined with Ballistic Missiles

With the introduction of submunitions, TBMs should increase their military effectiveness in significant ways. Figure 16 shows the number of mines, from a single TBM warhead containing 150 mine submunitions, that can be expected to land on a 25-meter-wide runway, or on a 10-meter-wide apron to a runway, as a function of the CEP of the TBM. This figure demonstrates that the introduction of submunitions on TBMs enhances their capability for closing air bases over the capability of a unitary warhead missile even without improvements in missile accuracy. In Figure 15 we showed that about eight to ten TBMs with 50 meter CEP would be required to close or crater a runway with high assurance; here we see that one 300 meter CEP TBM can be expected to place about ten mines on a 25-meter-wide runway and about six mines on a 10-meter-wide apron. Each of these submunitions could create a crater on the runway or apron. A crater on the runway would have to be filled and smoothed, and the mines would have to be removed to allow flight operations to continue. The number of TBMs with submunitions to close a runway would depend on the length of the runway and the aircraft operating on it. Air base operations may be halted for hours until repairs are completed or the mines are successfully removed.

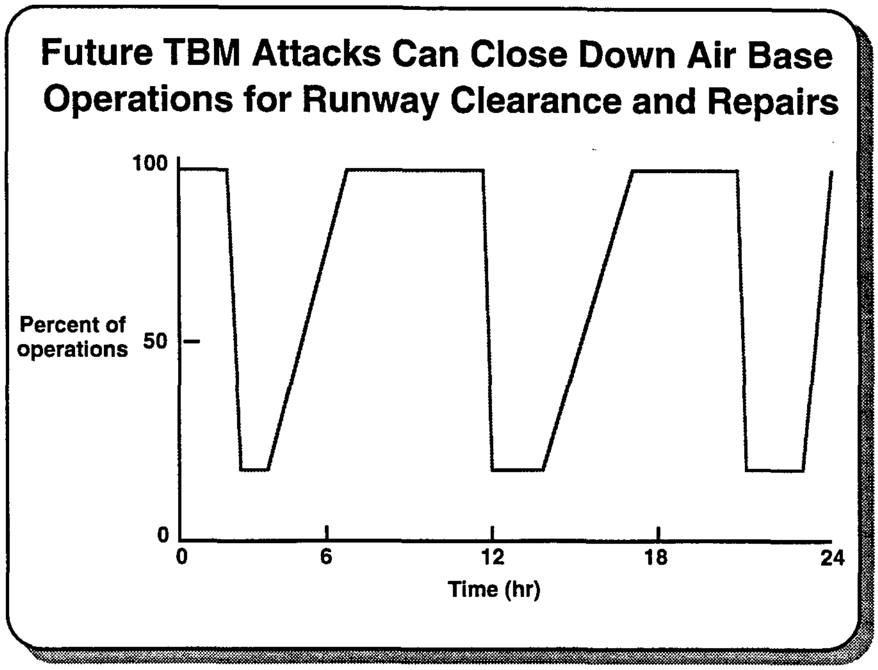

Figure 17—Future TBM Attacks Can Close Down Air Base Operations for Runway Clearance and Repairs

Figure 17 shows conceptually what we anticipate could happen to air base operations with the introduction of advanced TBMs. We would expect that base closure could last for several hours if the runways were cratered or were covered with explosive mines that had to be cleared before flight operations could continue. If base flight operations are closed for an extended number of hours, air supply operations will cease and air defenses will suffer, as will the ability to support EEF ground forces with air cover. If such enemy actions against the base can be coordinated with their ground attacks, EEF ground forces may find themselves under siege and outnumbered by both enemy air and ground forces. We see the emerging TBM threat as one element of a campaign to successfully dislodge or defeat the EEF. For comparison, Figure 17 illustrates the potential for much greater periods of air operations disruptions than are shown in Figure 9, which is associated with TBM attacks using unitary warheads.

Accurate and Stealthy Cruise Missiles May Be a Threat in the Next Century

- Not a validated threat in the Third World
- Variable ranges up to 2000 km
- Payloads up to 1000 kg
- Accuracy of 50 m with GPS-inertial guidance
  - Could reach 5 to 10 m with map matching
- Acquisition of U.S.-size cruise missiles by AWACS ≤ 80 miles:
  - Without improved AWACS detection of stealth CM uncertain
- Velocity up to 500 mph
- France and Russia may be selling technology and know-how to newly industrialized nations

Figure 18—Accurate and Stealthy Cruise Missiles May Be a Threat in the Next Century

Another threat that may emerge in the next decade is a low-flying, long-range, and accurate cruise missile (CM) much like the U.S. Tomahawk cruise missile. Its range could reach 2000 km and carry up to a 1000-kg warhead that might carry submunitions. Using the Global Positioning System (GPS) and an inertial guidance system, cruise missiles are expected to achieve 50 meter accuracies against fixed targets. If a map-matching guidance system can be employed, like the United States employed in its earlier precision-guided munitions, it might be possible for Third World cruise missiles to achieve accuracies of less than 10 meters. Defense against these cruise missiles might be difficult given their size and the limited capacity of radars to see them. It is estimated that a current U.S. cruise missile might be detected by an Airborne Warning and Control System (AWACS) out to a range of about 80 miles, but if stealth technologies are employed in the design of these new cruise missiles, the detection range of AWACS will be substantially reduced. Because these CMs can attain velocities approaching 500 mph, it may be difficult, given the limited range for their detection, for air defenses to successfully respond to a CM attack.

Although we indicate that the long-range, stealthy cruise missile threat has not yet been validated for Third World countries, several countries, such as France and Russia, are known to be developing cruise missiles—possibly for export.

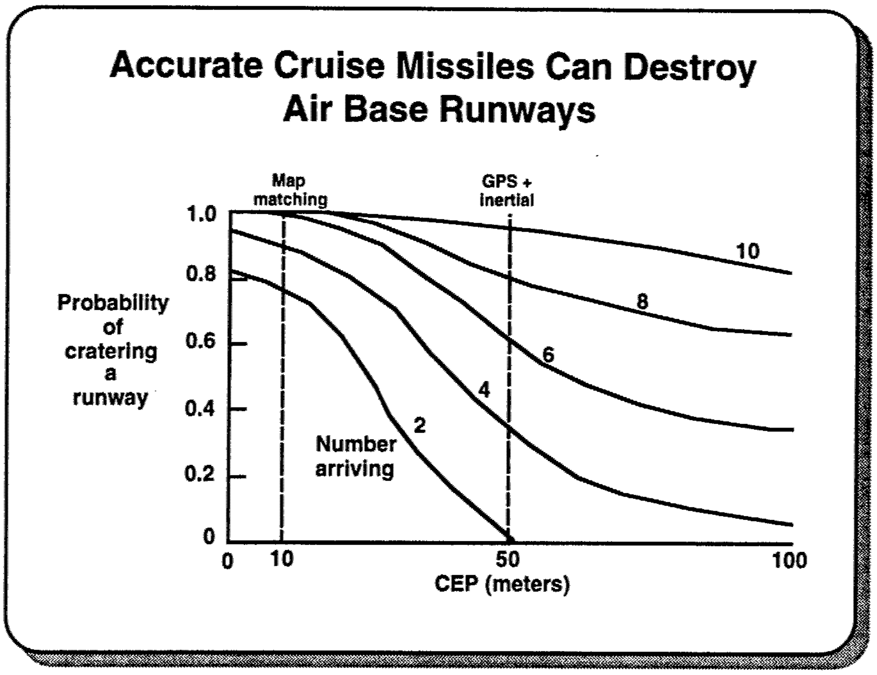

Figure 19—Accurate Cruise Missiles Can Destroy Air Base Runways

Figure 19 shows the results of calculations on the number of cruise missiles required to crater a runway as a function of the cruise missile's accuracy. The numbers shown are for a unitary warhead and do not differ significantly from comparably accurate numbers for (50 meter CEP) unitary TBMs needed to crater a runway. With more accurate map-matching guidance that yields a 5 to 10 meter CEP, about eight to ten cruise missiles are estimated with a 0.9 probability to be able to close a runway with two or more craters. Cruise missiles may be equally effective against air base operations as TBMs, or more so if they can incorporate map-matching guidance, submunitions, or both.

As mentioned earlier, AWACS is estimated to be able to detect a Tomahawk cruise missile at ranges of about 80 miles, and given that the AWACS could be located at about that distance (or less) behind the intended cruise missile target, there may be little opportunity to give timely attack warning to the target, let alone react with air defenses. A stealth cruise missile design would seriously exacerbate this situation.

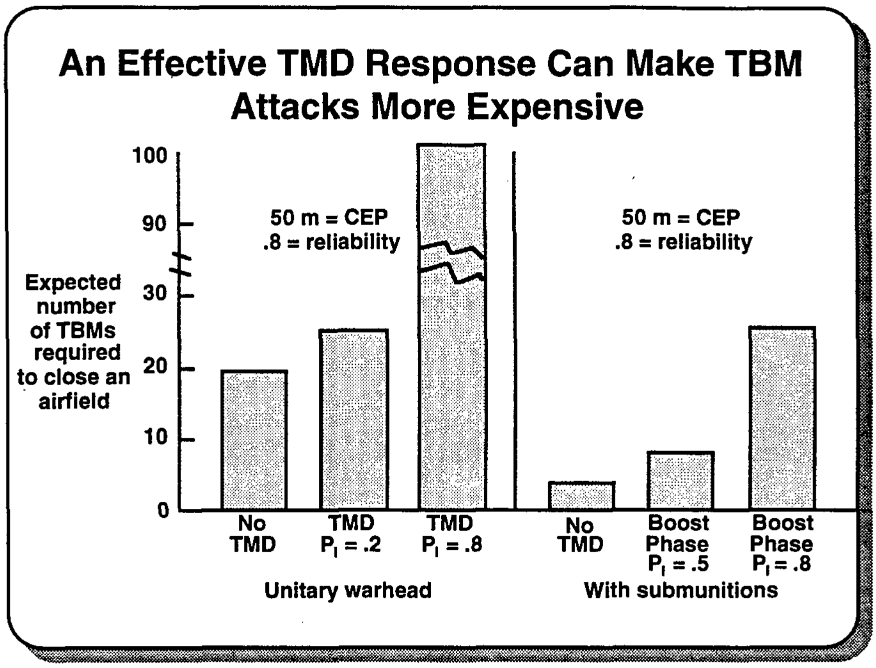

Figure 20—An Effective TMD Response Can Make TBM Attacks More Expensive

One possible response to make TBM attacks more expensive is to introduce theater missile defenses (TMD). Figure 20 shows the expected number of TBMs with unitary warheads, or with submunitions, needed to close an airfield with at least two craters or mined areas along the 2000–3000 m airstrip, with and without the introduction of TMD. TBMs with unitary warheads can be defended against by terminal ground-based TMD. TBMs with submunitions are expected to disperse submunitions while at ranges beyond the reach of the ground-based TMD. To avoid submunition deployment, a TMD might in the future have to be capable of intercepting the TBM during boost phase. An upper tier system such as THAAD or the Navy's LEAP could force an adversary to deploy its TMB submunitions early in its trajectory, possibly well before apogee.

It can be seen from Figure 20 that the increase to the number of TBMs required to close an airfield is little affected by a terminal TMD system that has a limited ability to intercept attacking missiles. Against a terminal ground-based TMD with a intercept probability of 0.2, it is estimated that two additional TBMs are required to close the airfield, whereas the number of TBMs required if the intercept probability is 0.8 increases from about 20 to about 100.

Poor defenses give limited leverage against a TBM attack, but reasonably good defenses can provide leverage against a TBM attack. This leverage also holds for boost-phase TMD against TBMs using submunitions that are much more effective in closing runways than are unitary warhead TBMs. Boost-phase TMD will be either air or space based, and will probably be supplied by the Air Force if developed and deployed, whereas ground-based TMD will be supplied by the Army. Effective defenses can achieve significant leverage in the number of TBMs required to close an air base, but TMD may not be the most cost-effective solution for the EEF to consider.

The situation can be made more complicated by considering the attacker's options. He could, for example, use fewer TBMs and be less certain of closing the air base, or, if the attacker has good intelligence, he could use fewer TBMs on average by halting a sequential TBM attack when the runway has been successfully cratered.

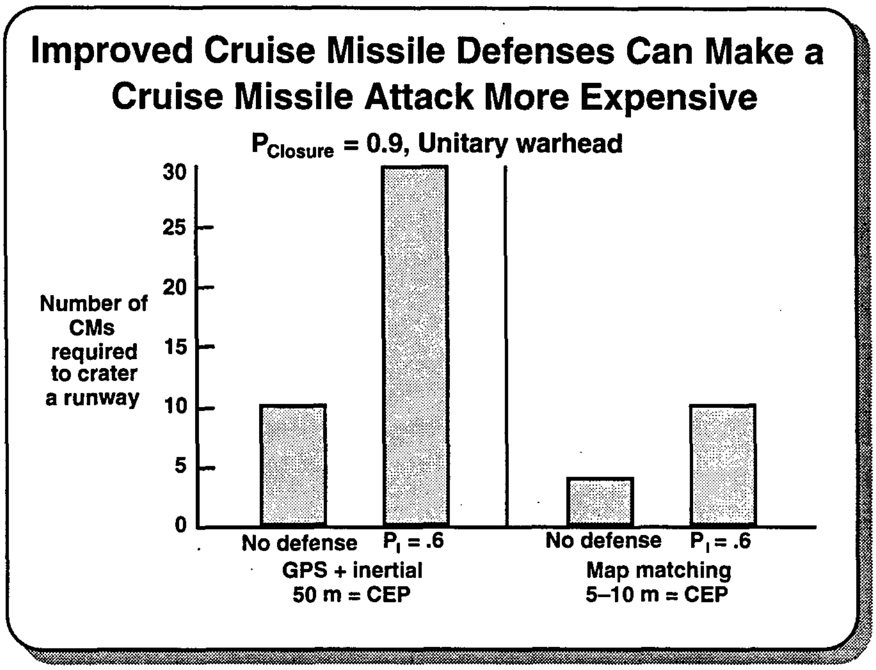

Figure 21—Improved Cruise Missile Defenses Can Make a Cruise Missile Attack More Expensive

Figure 21 illustrates the leverage that could be obtained against cruise missile threats by the introduction of cruise missile defenses (CMD). These defenses could use either air-to-air or surface-to-air missiles to intercept cruise missiles. Defenses that can intercept an attacking cruise missile with a 0.6 probability of success can force the number of cruise missiles required to crater an airfield runway to increase by about a factor of 3. An air-to-air defense system would require adequate detection range to allow defense aircraft on alert time to scramble and locate the cruise missile target. As noted earlier, however, this may be difficult to do given the limited detection range of cruise missiles unless interceptor aircraft are already airborne. Depending on the specifics of the EEF scenario, there are a variety of candidate ground-based air defense systems that might be considered for future deployment against cruise missile attacks. With the introduction of a map-matching system for cruise missile guidance, only four cruise missiles are required to crater the air base runway, allowing the attacker to regain the leverage lost to the defense when using the less accurate cruise missiles. These calculations do not consider submunitions, such as mines, dispersed by the cruise missile. Submunitions are possible, and may be even more effective in closing air bases.

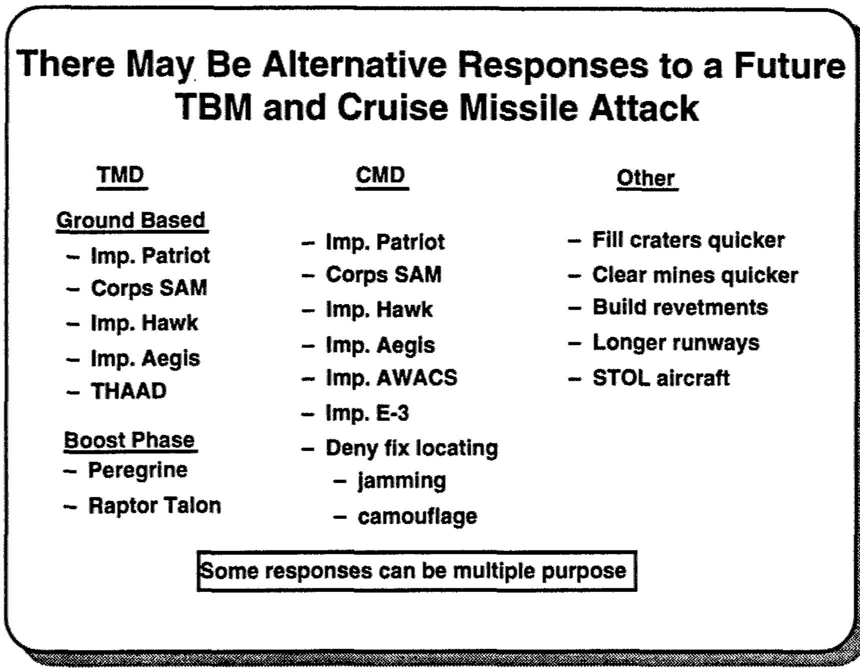

Figure 22—There May Be Alternative Responses to a Future TBM and Cruise Missile Attack

There are a variety of potential responses for the EEF to consider against future TBM and cruise missile threats. For the TBM threat, several candidate ground-based TMD systems could be deployed along with the EEF, including improved Patriot, improved Hawk, improved Aegis, and THAAD (Terminal High-Altitude Advanced Defense). Boost-phase TMD programs—Peregrine and Raptor Talon—are in the Air Force concept development phase and are not yet scheduled for future deployment. All but THAAD and Raptor Talon could improve cruise missile and air defenses as well.

Enhanced cruise missile defenses might be achieved by improvements to the AWACS and the Navy E-2 airborne early warning aircraft. Consideration might also be given to countermeasures to deny navigational aid to cruise missile guidance systems, whether by local jamming of the GPS or camouflage against map-matching guidance systems.

In addition to considering TMD or CMD, it is equally important to consider methods for dealing with the effects of such attacks. For example, more rapid filling of craters on runways or the rapid removal of submunitions from runways should reduce the operational downtime of air bases under TBM and cruise missile attack. Suggestions to consider for clearing mines from runways include the use of blades attached to an armored vehicle or the use of water jet streams from high-powered hoses located behind protective barricades. Other engineering approaches, such as building revetments to protect aircraft or extending or adding runways, may also be cost-effective responses to such attacks. Moreover, engineering solutions may require little additional equipment, if equipment already scheduled to accompany the EEF can be modified. The use of short takeoff and landing (STOL) aircraft would obviate the threat of closing runways with TBM or cruise missile attacks.

TBM with Submunitions Can Enhance Threat to Ground Forces

- A single 1000 kg TBM with fragment submunitions could be effective over 1/4 mi^2 area
  - Harass and disrupt ground operations
  - Cause casualties
- Response if threat is validated
  - Upon warning, take protective measures
  - Disperse over larger area—preclude detection by enemy reconnaissance

Figure 23—TBM with Submunitions Can Enhance Threat to Ground Forces

The use of TBMs with submunitions could be more threatening to ground EEF than TBMs with unitary warheads. A preliminary calculation suggests that a 1000-kg submunition warhead could place a 1/4 oz. pellet every 200 square feet over a 1/4 square mile area. An attack of this kind could cause casualties among the EEF ground troops, but it would probably not be any more effective than artillery fire. Such attacks could be disruptive to EEF ground operations, but it would require the attacker to have fairly accurate knowledge, within a few hundred meters or less, of where the ground force units were located. The possible troop responses to TBM attacks with submunitions include those typical to incoming artillery fire—to seek cover or duck to minimize exposure. Communication security practices should be considered by the EEF ground forces to limit the enemy's capability to locate EEF positions.

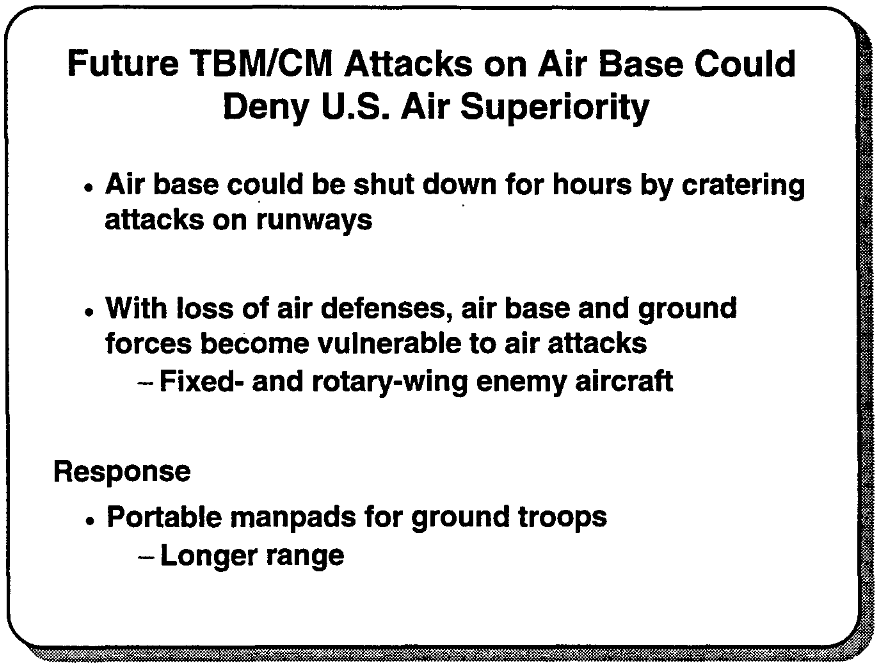

Figure 24—Future TBM/CM Attacks on Air Base Could Deny U.S. Air Superiority

The successful cratering or scattering of mines on air base runways can close down air operations for several hours at a time. With the halting of air operations, air defense capabilities will also diminish, if not halt altogether, leaving the air base and EEF ground forces vulnerable to enemy air attack. EEF ground forces are expected to have man-portable and vehicle-launched Stinger SAMs. Consideration should be given to developing improved longer-range SAMs to counter standoff anti-surface missile (ASM) attacks against the EEF ground troops. The number of manpads taken in by the EEF should also be considered in light of the TBM and cruise missile threats and their potential for closing air bases and halting air defense missions from those bases.

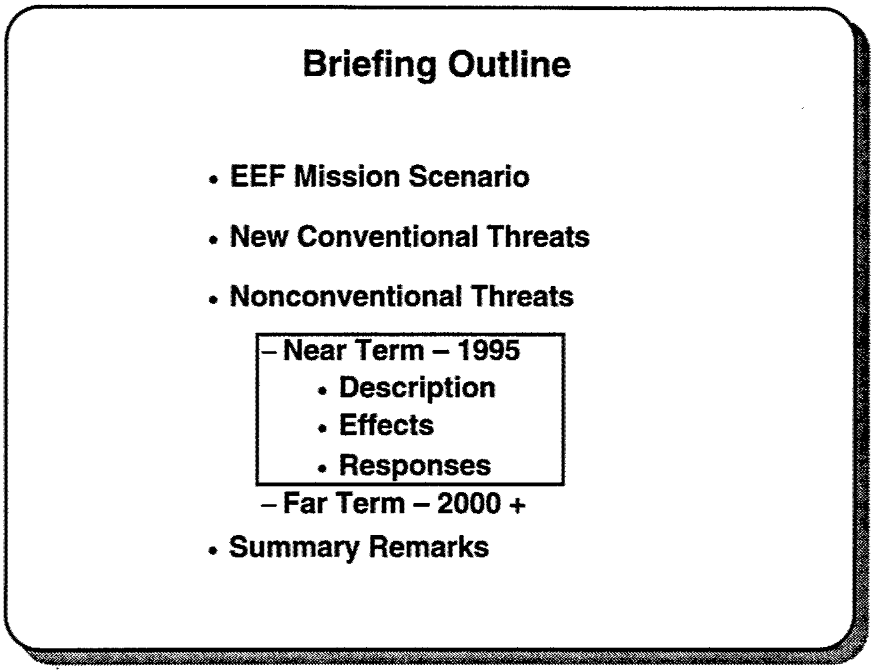

Figure 25—Briefing Outline

We now turn to a review of the near-term nonconventional threats. Here the primary concern is for the use of chemical weapons against the EEF, particularly if delivered by ballistic missiles. Concern is also raised for the potential of radio jamming by an enemy to preclude warning EEF troops of a CW attack. Concern for the use of biological weapons (BW) against the EEF also exists, but there are many uncertainties about the use and utility of BW as compared to CW, making any valid assessment of the BW threat problematic at this time.

The Context for the Near-Term CW Threat

- CW are outlawed by international treaty, but 20 nations have pursued or are pursuing CW
- Nations may be deterred from using CW against U.S. forces—fearing retaliation with conventional weapons
  - Response needs to be balanced
- Assume EEF will take minimal precautions against CW attack by aircraft and artillery
- Adequate warning time essential for troop protection; enemy jamming of communications a concern

Figure 26—The Context for the Near-Term CW Threat

Chemical warfare is one of the more important nonconventional threats that the EEF may have to consider. Some 20 nations are believed to have developed or are developing CW. On the other hand, 133 nations have recently initialed (preliminary to ratification, but an indication to do so) the Chemical Weapons Convention of 1992 that bans the manufacture and storage of CW agents and reaffirms the Geneva Convention of 1925 ban on the use of CW. In violation of the Geneva Convention, Iraq not only used CW against Iranian forces in the Iran-Iraq war during the 1980s, but also used CW against their own Kurdish population.

Iraq did not use its vast CW capability in Desert Storm, where U.S. forces were involved. Speculation is that Iraq may have been deterred by the threat of U.S. retaliation and the eventual capture of Baghdad if CW were used against UN or, especially, U.S. forces. Other speculation is that Iraq was outflanked by UN forces and had little opportunity to employ its CW on the battlefield, but might have done so if UN forces continued their move on Baghdad.

Whatever the reasons for CW not being used by Iraq in Desert Storm, it is not axiomatic that countries that have CW will use them. Thus, as we define the potential CW threat we need to reflect on how to devise a balanced response for the EEF to deal with this threat. Balance may include the readiness to deal with CW attacks on the battlefield, as well as the threat of military, political, and economic retaliation.

We assume that the EEF will have at least minimum CW defenses—protective clothes (MOPP gear), gas masks, and warning devices—when they embark on their mission, and will have practiced their use against CW attacks by artillery and aircraft. Since warning time is essential to a successful CW defense, we are concerned with the possibility that enemy jammers may interfere with the warning communications of a CW attack, especially to those EEF ground forces deployed at a distance from EEF headquarters. Warning at an air base or other major military facility can readily be accomplished by sounding a Klaxon or siren.

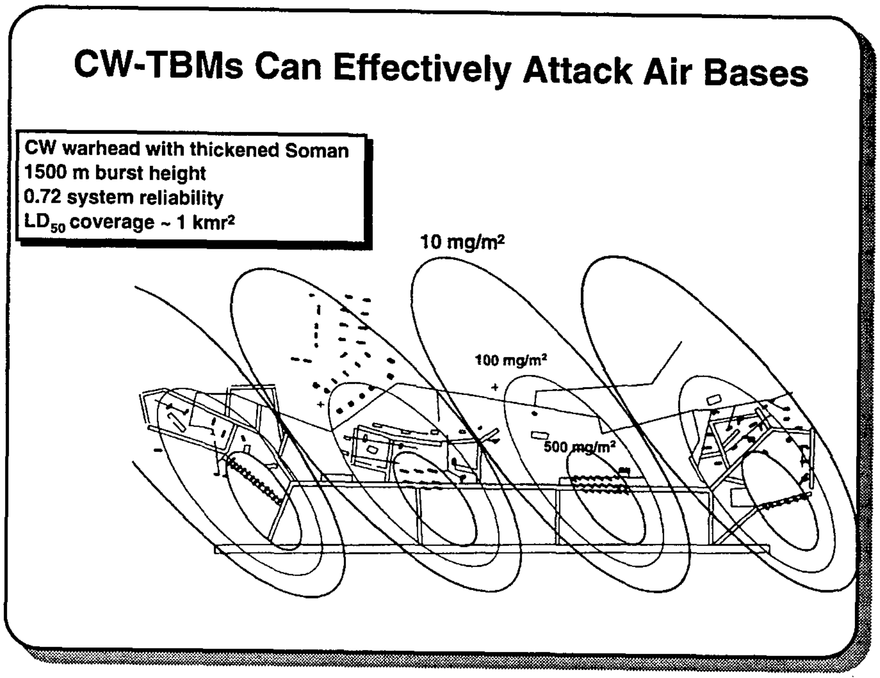

Figure 27—CW-TBMs Can Effectively Attack Air Bases

Figure 27 schematically illustrates how CW could be delivered and dispersed by TBMs. In this illustration, the nerve agent Soman is released from TBMs at an altitude of 1500 meters. The mean lethal dose of Soman is 100 mg/sq m, and in this illustration covers about 1 sq km when dispersed in this manner. To cover the entire base with a mean lethal dose of Soman would require ten TBMs with a 0.72 reliability, or seven TBMs that are 100 percent reliable. The casualties caused by such an attack on an airfield will depend on how much warning time is available for the troops to don protective gear or reach protective cover, and whether the gear is used properly by the troops. There are many questions of how rapidly and how well an air base can be decontaminated and return to operations. If decontamination is not thorough, a persistent CW agent could be stirred up and cause casualties among unprotected troops many hours after the CW attack was first initiated.

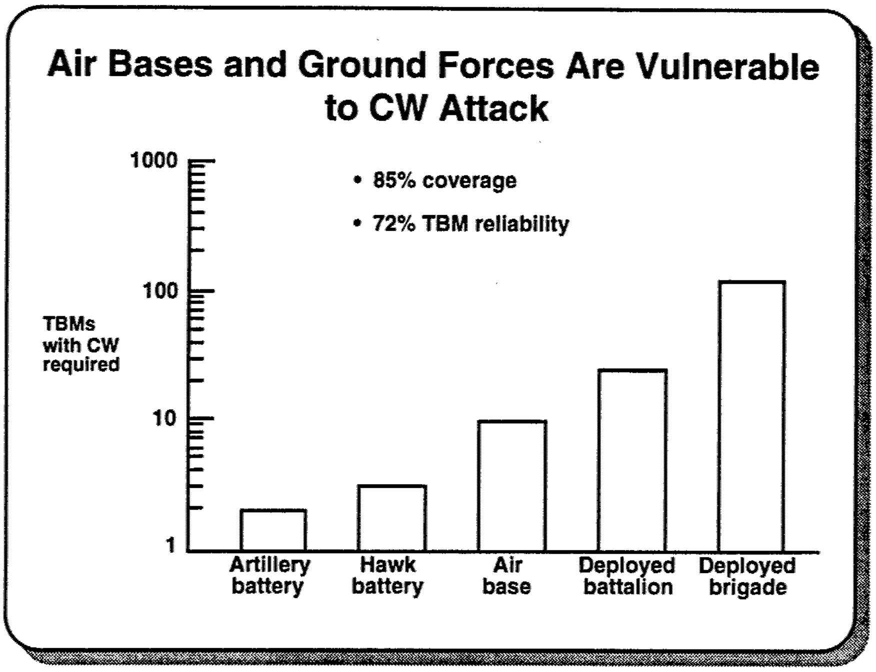

Figure 28—Air Bases and Ground Forces Are Vulnerable to CW Attack

Figure 28 shows the number of CW TBMs needed to achieve an 85 percent coverage of various target types. It is estimated to take about 10 CW TBMs to achieve 85 percent coverage of an air base with a mean lethal dose of Soman, and 25 CW TBMs to achieve coverage of 85 percent of a battalion deployed over an area of about 18 sq km. This assumes that the enemy has reasonably good knowledge of the battalion's location and that battalion units are distributed over the 18 sq km. Many fewer CW TBMs would be required to simply pin down an EEF battalion and force the troops to wear gas masks and MOPP gear continually if attacked with a CW TBM every few hours or so. Nonetheless, a significant CW attack against an air base or EEF ground forces could close the base and halt air and ground operations until decontamination is completed, as well as cause extensive casualties among the troops if there is inadequate warning time. Indeed, casualties can be expected even with adequate warning given the less than perfect reliability expected of the protective gear.

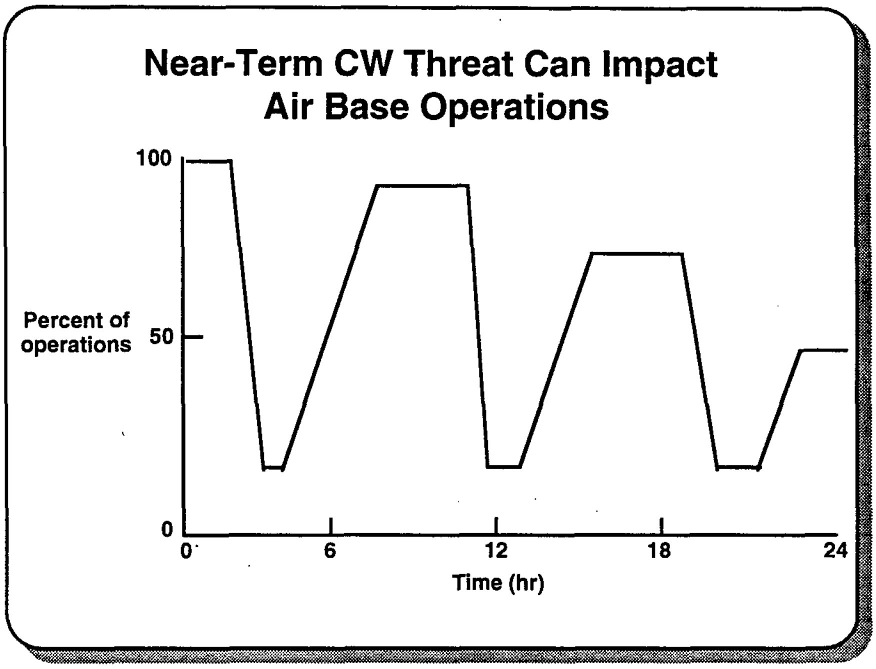

Figure 29—Near-Term CW Threat Can Impact Air Base Operations

Figure 29 shows conceptually what we expect the effect upon air base operations to be after successive CW attacks. It might be possible to decontaminate significant portions of an air base to resume operations in five or six hours, but we are not certain. Moreover, we feel that after successive CW attacks, depending on how extensive they are, operations will be precluded from returning to normal, or to 100 percent, because some operational areas of the air base will be difficult to totally decontaminate. It has been suggested that an extensive or long-lasting CW attack on an air base will force the abandonment of that base by the Air Force to ensure that further casualties do not occur from residual CW agents in the area.

By comparison, the disruption of air operations from a CW attack shown in Figure 29 may be more extensive and longer lasting than that from a TBM attack using conventional weapons (see Figure 17).

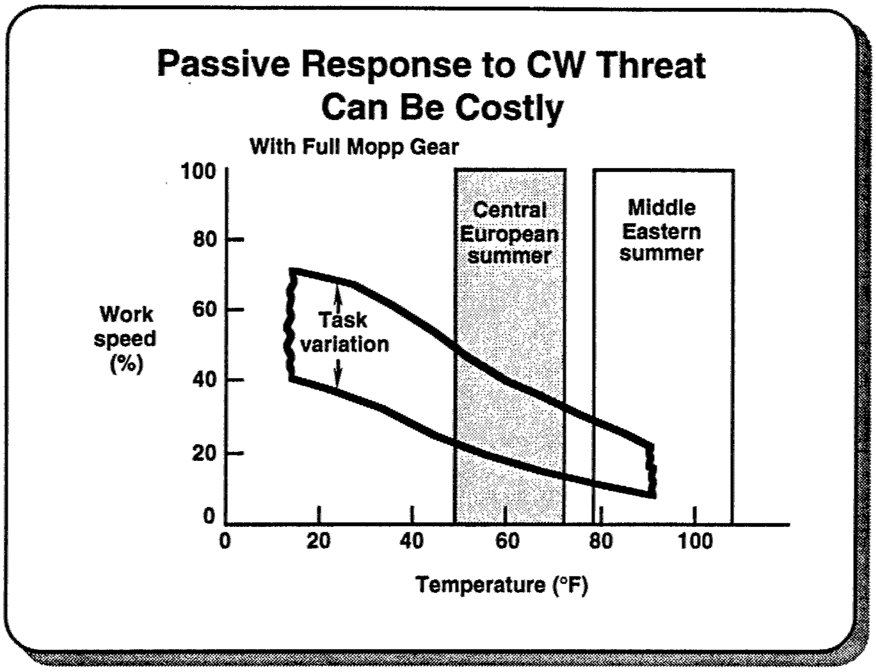

Figure 30—Passive Response to CW Threat Can Be Costly

The difficulty caused by a CW attack and the need to wear protective gear are demonstrated in Figure 30, which shows the rate or speed that work can be accomplished when wearing CW protective gear, as compared to work speed when not wearing any gear. The estimates of work speed are based on tasks requiring moderate to heavy manual labor. Under wintry conditions work speed is reduced by about 50 percent and under summer conditions work speed can be reduced by 70 to 80 percent. Tasks such as runway repair, aircraft and vehicle maintenance, trench digging, and firing heavy weapons will be severely inhibited if not halted altogether. Indeed, there are doubts as to whether troops can work longer than 15 minutes before tiring and requiring rest in summer climates.

Adequate Warning of a CW TBM Attack May Be Difficult to Achieve

Missile Range	Warning Time* (minutes) Current Capability	Maximum Possible Now
100 km	<1	3–4
300 km	5–6	5–6
500 km	8–9	8–9

* Warning time = time to target after detection + CW dispersal time

Figure 31—Adequate Warning of a CW TBM Attack May Be Difficult to Achieve

Avoiding high casualty rates from a CW attack will minimally require sufficient warning time of the attack to ensure that the troops can take adequate defensive measures. Warning can be tactical warning of a missile attack or of the detection of a CW cloud dispersed from a TBM. Figure 31 illustrates the current and maximum warning time as a function of the TBM range. For CW attacks by TBMs with 100 km or less range, the warning time the EEF can count on today is probably less than a minute. There is no sure method for detecting the launch of these short-range missiles from space or on the ground, unless a ground-based TMD radar is available. The launch of longer-range missiles may be detected from space by the Defense Satellite Program (DSP) satellite, giving additional tactical warning time, although there is no way to determine whether they are CW TBMs. For TBMs with ranges of greater than 300 km, warning time includes the missile time of flight after its detection and about one minute more for the CW agent to reach the target after its dispersal. For TBMs with 100 km range or less, without DSP warning, visual observation of the airburst would be required for any immediate warning. CW detectors located with the forces on the ground would detect the attack, but with no warning for troops to respond.

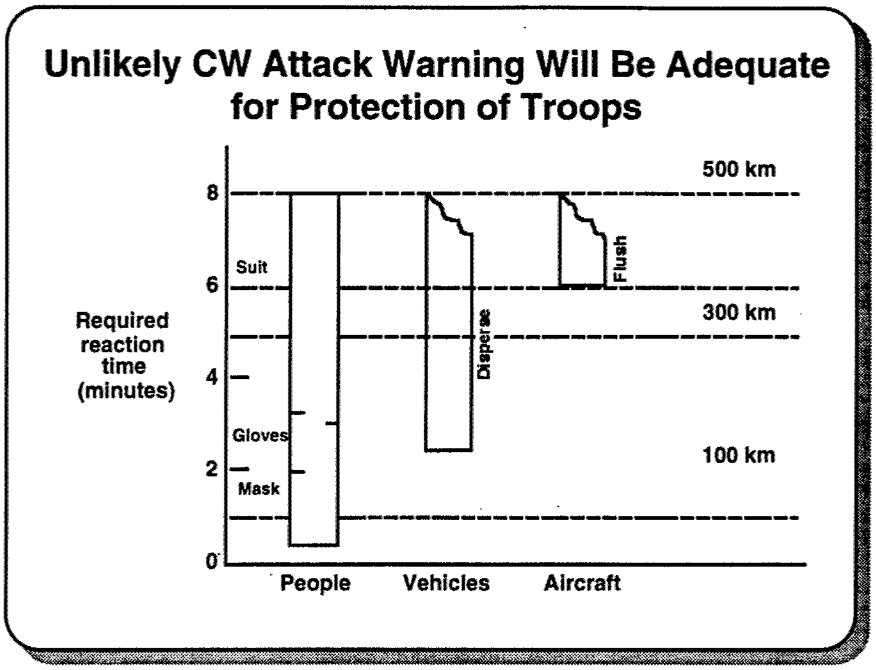

Figure 32—Unlikely CW Attack Warning Will Be Adequate for Protection of Troops

Figure 32 illustrates the time required to react to a CW attack by donning protective gear or leaving the affected area, and compares that to the available warning time of a CW TBM attack for different range TBMs. The donning of gas masks and gloves is estimated to take about three minutes from initial warning, and to properly don MOPP gear about five minutes more.[2] The figure indicates that there is insufficient time to respond at all to the shorter-range CW TBM threat of 200 km or less, and to respond adequately to the 300 km range threat troops must be wearing at least their protective suits before the attack. The EEF troops, therefore, can become vulnerable to an attack by CW on short-range TBMs. As pointed out earlier, the short-range TBM threat is currently large and is expected to continue to be a major portion of the TBM threat beyond 2000. These missiles are not necessarily loaded with CW.

With adequate warning, vehicles and aircraft can be moved or deployed away from the area under attack by CW. Aircraft can relocate to other bases. Vehicles, however, must know where to go to avoid the CW and it

[2]If forces are alerted and already partially in protective gear, gas masks can be donned in about 15 seconds.

is not certain how that might be accomplished if the CW attack is over a relatively wide area.

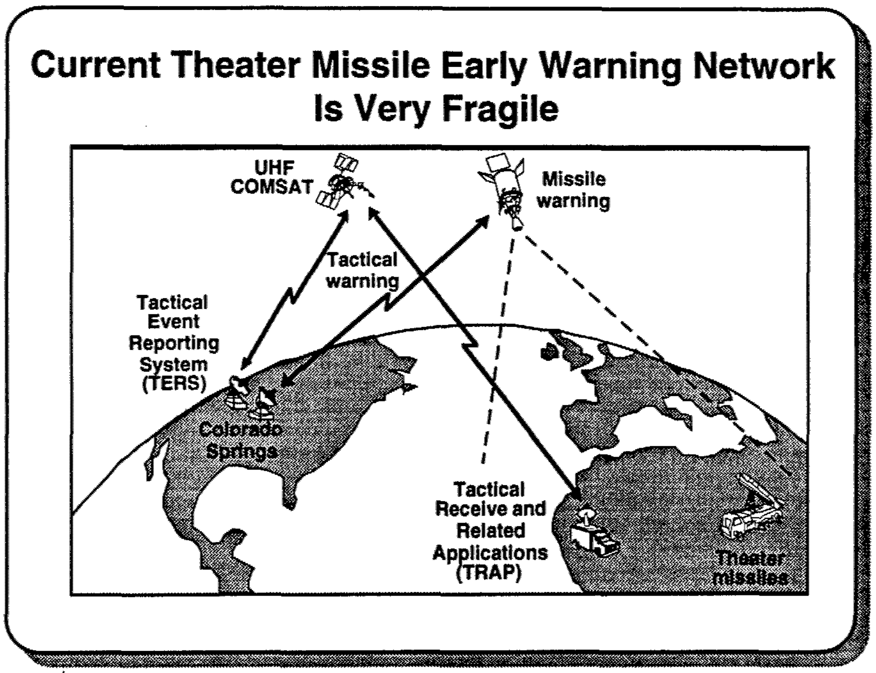

Figure 33—Current Theater Missile Early Warning Network Is Very Fragile

Because warning for CW defenses is so important, there is concern for the possible loss of that warning by enemy intervention. Figure 33 depicts the current TBM early warning network used in Operation Desert Storm. It shows that a satellite-detectable missile launch is first noted at the United States Space Command in Colorado Springs. Notification of the enemy missile launch is then communicated via satellite to the affected forces. Since the communications satellites are in orbit some 20,000 miles away from the ground receiving antenna, it is possible that an enemy with relatively low-power airborne jammers less than 100 miles away from the ground station could interrupt and jam the missile launch warning message from Colorado Springs. Intermittent jamming of the satellite link would preclude using the jamming signal itself as warning of a missile launch.

The Army is currently pursuing the development and deployment of a small joint tactical ground station (JTAGS) that would be capable of receiving data from early warning satellites in the deployment region. This may alleviate the enemy jamming problem, but it is not certain at this time because the ratio of the ranges between the receiver and the satellite and the receiver and the jammer is still very large.

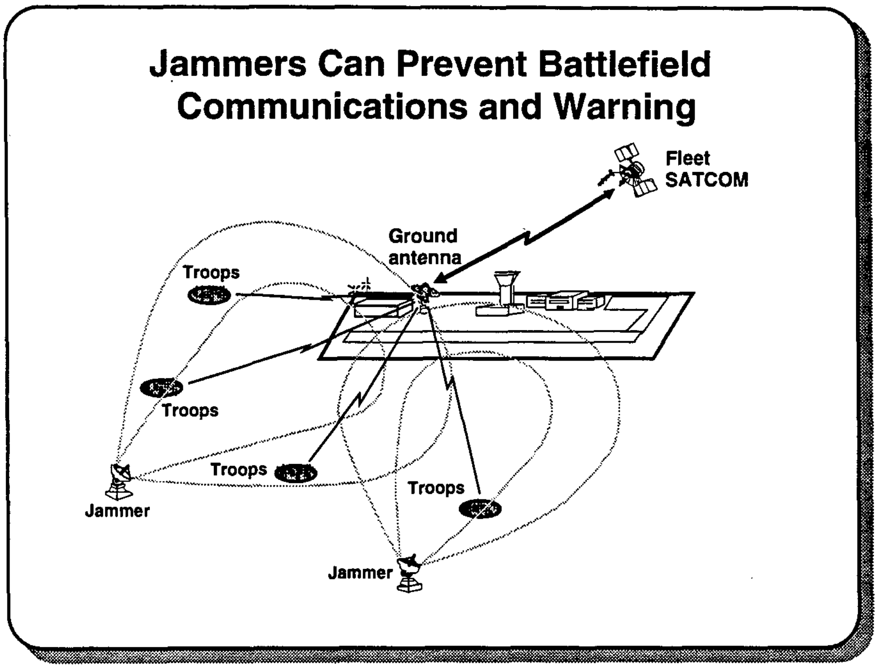

Figure 34—Jammers Can Prevent Battlefield Communications and Warning

Figure 34 shows conceptually how the satellite signal warning of a missile attack can be jammed. Moreover, enemy jammers in this scenario can also jam communication from the command headquarters at the air base to the EEF deployed remotely from the base as well as communications between the deployed EEF units. Again, it would likely require that enemy jammers be airborne and powerful enough to be effective, which could make them detectable and vulnerable to attack if they remained airborne for more than a few minutes.

Adequate Responses for Short-Range TBM-CW Threat May Be Difficult to Achieve

- Rapid, reliable warning system to all forces, particularly dispersed ground forces
- Additional CW defense measures for all TBM-CW threats
  - Adequate MOPP gear, masks
  - Protective tents, shelters
  - Medical treatment
  - Decontamination supplies—water
  - Dispersed supplies—plastic covers
- For short-range TBM/CW threat, continuous wearing of MOPP may be essential
  - Don mask and gloves on warning
- SAM-manpads for ground forces for self-defense against enemy air attack if air base is closed

Figure 35—Adequate Responses for Short-Range TBM-CW Threat May Be Difficult to Achieve

There is no easy solution or simple response for the EEF to a CW TBM threat. Efforts should be made to ensure that there is the maximum possible warning time available to the EEF to respond to a CW missile attack. Because multiple CW attacks are possible, it will be important for the EEF to have adequate quantities of CW defensive gear, such as protective suits, gas masks, medical supplies, detection devices, and decontamination supplies if their mission is not to be aborted. If minimal warning for donning MOPP gear is forthcoming, then increased numbers of portable tents with filtered vents can serve as temporary protective shelters to allow additional time for the EEF to don their masks and protective clothing. There will continue to be serious questions about whether there can be effective decontamination, and whether affected forces can readily be brought back to operational status. Protective tents can probably serve dual purposes in field operations and may not require an extensive logistics trail. If a short-range missile and CW threat is assessed by intelligence as probable, the EEF may at some point have to wear their protective suits continually, putting on their masks and gloves when warning of an attack is sounded.

If a CW attack succeeds in closing down air defense and air cover operations at the local air base for extended periods, EEF ground forces as well as those at the air base will become susceptible and possibly vulnerable to enemy air attacks. The numbers and availability of portable or vehicle-mounted SAMs carried by the EEF should be reviewed to ensure adequate protection remains if the nominal air defenses are lost.

Briefing Outline

- EEF Mission Scenario
- New Conventional Threats
- Nonconventional Threats
  - Near Term – 1995
  - Far Term – 2000 +
    - Description
    - Effects
    - Responses
- Summary Remarks

Figure 36—Briefing Outline

We now turn to the far-term nonconventional threat in which the CW on TBMs can be mixed with other new conventional weapons systems.

The Future CW Threat to the EEF Could Intensify

- Mixed attacks of conventional and chemical munitions may be more effective against air bases and ground forces
  - Improved enemy C^3
- Mix can include CW TBM, TBM with submunitions, and cruise missiles following up
  - Accurate and rapid reload missiles
- EEF responses may be costly and uncertain
  - Warning time remains an issue
- The need for the U.S. to be able to deter a CW attack may grow

Figure 37—The Future CW Threat to the EEF Could Intensify

Beyond the year 2000, CW attacks may be mixed with new and improved TBMs and cruise missiles may be even more effective against air bases and EEF ground forces than they are today. Improved enemy command and control will allow for multiple and coordinated TMD and cruise missile attacks against EEF targets. TBM submunitions may be able to litter runways that have been covered with a virulent CW agent delivered by other TBMs. The problems for the EEF will continue and sufficient warning time to react to a CW attack will remain difficult to achieve. It is clear that the potential for thwarting the EEF mission will be great unless there exists a successful deterrent policy that significantly reduces the prospect that CW will be used against U.S. military forces.

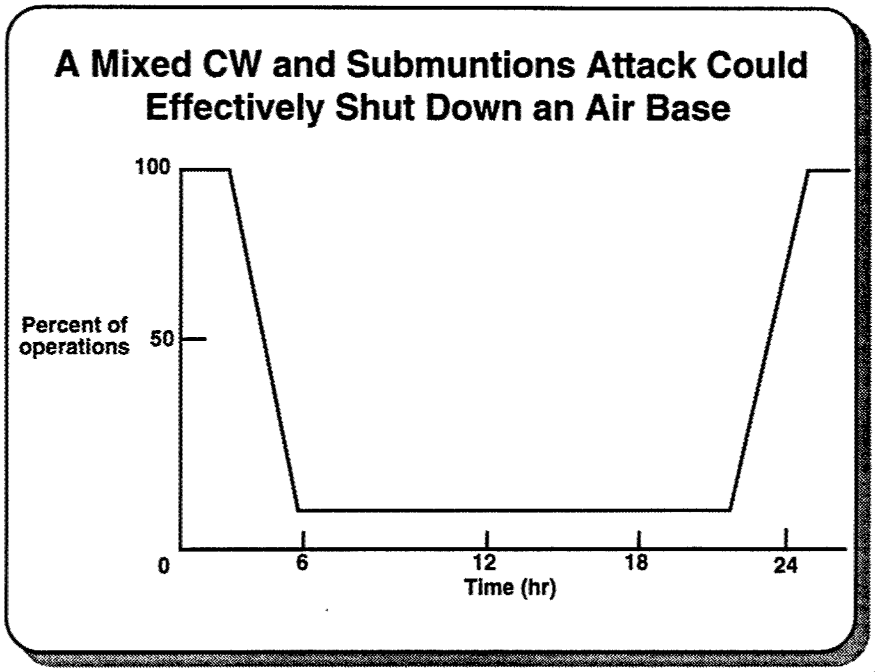

Figure 38—A Mixed CW and Submunitions Attack Could Effectively Shut Down an Air Base

Figure 38 illustrates notionally what we expect will happen to the operational capability of the EEF-protected air base in light of a mixed TBM attack with both submunitions and CW. We expect that the clearing of the runways and decontamination of the air base will require 24 hours or more, given the requirement that much or all of these clearing and decontamination activities would be accomplished while the troops were in protective gear and working at a fraction of the speed possible without that cumbersome gear. Without further protection against enemy air and ground forces, attacks of this type may force the abandonment of the EEF mission.

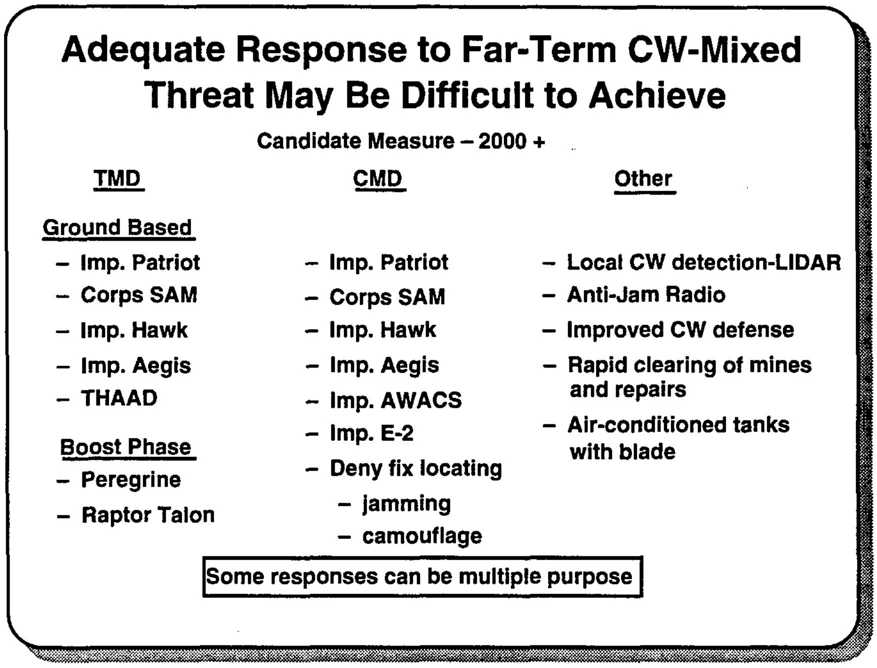

Figure 39—Adequate Response to Far-Term CW-Mixed Threat May Be Difficult to Achieve

Figure 39 depicts a list, not unlike the one shown earlier (see Figure 22), of possible responses to the TBM and cruise missile threats that the EEF might consider having with them. Also listed are other nonactive defense possibilities against these threats that could be available early in the next decade. Other possibilities include the use of a Laser Intensity Detection and Ranging (LIDAR) system that can detect CW clouds many kilometers away. This could give the troops an extra couple of minutes to put on their gas masks or to enter a protective tent and put on their protective suits. Making all the EEF vehicles CW proof would also help, as would an anti-jam communication system for warning the deployed EEF ground forces. Improved communications security could make locating and targeting the EEF ground forces more difficult and should be considered. Given the extreme environment caused by a CW attack, measures should also be considered that would allow many of the more difficult post-CW attack tasks to be done remotely or by robots. Clearing mines from a runway that has been doused by CW might be accomplished more rapidly by adapting a Sherman tank that can safely operate in a hostile CW environment with a specially hardened blade. Fire trucks located at air bases might be adapted to operate in a CW environment and high-pressure hoses could be used to remove explosive mines from the runway.

If the EEF are to operate in this future environment, they will require new ideas on how to do so. Many of the responses listed here are dual use and can defend against ballistic and cruise missiles and aircraft as well. These, however, could be heavy systems, and their transport and introduction into a hostile environment could give rise to a whole new set of vulnerability problems.

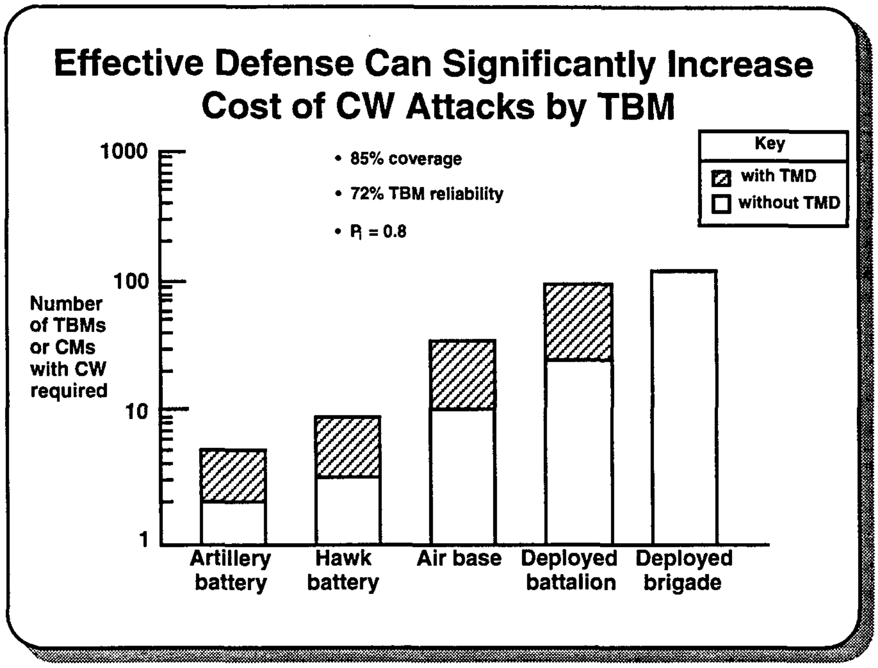

Figure 40—Effective Defenses Can Significantly Increase Cost of CW Attacks by TBM

Figure 40 shows the estimated number of CW-loaded TBMs or cruise missiles that will be required to cover 85 percent of a target that is actively defended with a TBM or CMD having an intercept probability of 0.8. To attack the air base requires nearly 40 TBMs or cruise missiles, compared with 10 when there are no active defenses. Similarly, nearly 100 missiles are needed to attack the EEF battalion with CW, compared with only 25 when there are no active defenses. Thus, effective TMD and CMD can exert significant leverage on an attacker. There are, of course, still many technical issues associated with the successful intercept of missile warheads containing CW. Moreover, the logistic requirements for deploying these active defenses may be difficult to achieve in a timely way in the early entry phase of combat.

Agenda Briefing

- EEF Mission Scenario
- New Conventional Threats
- Nonconventional Threats
- Summary Remarks

Figure 41—Agenda Briefing

The following summarizes the previous discussion and provides additional comments on the means and methods for selecting adequate responses to these new and potential threats.

A Summary of Responses

	Defense of	
	Air Base	Ground Forces
Current Threat • CW TBM • TBM	• Add CW defense equipment • SAM-manpads • Rapid troop deployment	• Add CW defense equipment • SAM-manpads
Future Threat • TBMs accurate – Submunitions • Cruise missiles • CW • Radio jamming	• Improved warning • Active vs. passive measures; CW, conventional • SAM-manpads • Rapid deployment • CW jamming	• Improved warning • Active CM/TBM defense vs. CW passive measures • SAM-manpads • Anti-jam radio

Figure 42—A Summary of Responses

Figure 42, shown earlier as Figure 2, lists many of the possible responses for the EEF discussed in reaction to the current and future threats and in defense of the air base and the EEF ground forces. The table of responses includes active and passive measures from rapid troop disembarkation and deployment away from the air base to the introduction of advanced TMD systems, either Army ground-based systems, Navy sea-based systems, or Air Force air-launched boost-phase interceptors. The underlying question is which of these responses is really required, and which are cost-effective responses?

A Priority for Responses May Be Established

	Defense of		
	Air Base	Ground Forces	If No CW Threat
Current Threat • CW TBM • TBM	• Add CW defense equipment • SAM-manpads • Rapid troop deployment	• Add CW defense equipment • SAM-manpads	• Rapid deployment
Future Threat • TBMs accurate – Submunitions • Cruise missiles • CW • Radio jamming	• Imp. warning • Active vs. passive measures; CW, conventional • SAM-manpads • Rapid deployment • CW jamming	• Imp. warning • Active CM/TBM defense vs. CW passive measures • SAM-manpads • Anti-jam radio	• Active defense vs. passive conventional defense • SAM-manpads • Rapid deployment
Independent of near- or far-term threat	• Add CW defense equipment • Rapid deployment • SAM-manpads	• Add CW defense equipment • SAM-manpads	• Rapid deployment • Manpads

Figure 43—A Priority for Responses May Be Established

After thinking about the priority among these responses, we modified Figure 42 by adding an extra column and an extra row. The additional row identifies those responses in defense of an air base and the EEF that are required now and in the future. That is, these responses are independent of any new emerging threat. For an air base, those responses include additional CW defenses, rapid troop deployment from the air base, and an assured quantity of portable SAMs. For the EEF ground forces, the time independent responses are improved CW defenses and portable SAMs.

The additional column identifies responses when the CW threat is discounted. This might be the case if the CW threat is judged to be largely finessed by an effective U.S. retaliatory policy. As shown in the third column, rapid deployment is considered important for both the current and future threat. Active defense versus passive conventional defenses and portable SAMs should also be considered for the future threat.

Finally, the intersection of the additional column and row yields those responses that are independent of time and that discount the CW threat. Programmatically, the independent responses should receive a high priority, while those responses geared for future threats should be considered for R&D.

Comparing Alternative Responses to the Far-Term Threat

Measure of Effectiveness	Passive Measures	Manpads	TMD	Rapid Deployment
Weight and size • Tonnage/container				
Cost • Dollars • Opportunity				
Effectiveness • Availability • Reliability				

Figure 44—Comparing Alternative Responses to the Far-Term Threat

If there is to be a balanced plan for responding to these new and emerging threats, it would be useful to look at the trade-off between the responses in terms of their relative costs and effectiveness and deployability, as shown in Figure 44. The logistic requirements to deliver the given response are important. For instance, a Patriot Pac II battery with eight launches requires 25 C-141 sorties and at least one C-5 sortie to transport it. The C-5 sortie is required because of the Pac II configuration. An additional chemical company or air defense battery would require 19 and 17 C-141 sorties, respectively, and none and one C-5 sortie. The cost-effectiveness of each response should be considered. If a new system or additional material is to be taken in with the EEF, what capabilities will be left behind? What will arrive later? Any inclusions into the EEF logistics package need to be reliable and available when needed, and should result in a net improvement in EEF effectiveness to achieve its early entry mission.

Although we have not made the analysis needed to fill out the table shown in Figure 44, the EEF should consider having it made so that a clearer picture could be generated regarding their options for handling TBM and CM threats. This concludes this review and discussion. Thank you.

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